NOAA Scientific Publications Report
February 18, 2014

Highlighted Articles

Potential impact of climate change on the intra-Americas sea: Part 2. Implications for Atlantic bluefin tuna and skipjack tuna adult and larval habitats
Journal of Marine Systems (2.476)

Long-term NOx trends over large cities in the United States during the Great Recession: comparison of satellite retrievals, ground observations, and emission inventories
Atmospheric Environment (3.062)

An extreme event of sea-level rise along the Northeast coast of North America in 2009–2010
Nature Communications (10.742)

Additional Articles

NOS Publications

Augmenting anti-cancer natural products with a small molecule adjuvant
Marine Drugs (3.512)

NMFS Publications

Development of an estuarine climate change monitoring program
Ecological Indicators (2.23)

Linking behavior, physiology, and survival of Atlantic salmon smolts during estuary migration
Marine and Coastal Fisheries (1.810)

Heterogeneity among *Mycobacterium ulcerans* from French Guiana revealed by multilocus variable number tandem repeat analysis (MLVA)
PLOS One (3.534)



NOAA SCIENTIFIC PUBLICATIONS REPORT
FEBRUARY 18, 2014

[Diagnosis of paired age agreement: a simulation approach of accuracy and precision effects]
ICES Journal of Marine Science (2.525)

NESDIS PUBLICATIONS

[Natural gas prices and the extreme winters of 2011/12 and 2013/14: causes, indicators, and interactions]
Bulletin of the American Meteorological Society (11.57)

[Calculation and evaluation of an air-freezing index for the 1981–2010 climate normals period in the coterminous United States]
Journal of Applied Meteorology and Climatology (2.10)

OAR PUBLICATIONS

[Tropical climate change control of the lower stratospheric circulation]
Geophysical Research Letters (4.456)

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS PUBLICATIONS

[White paper on Gulf of Mexico mercury fate and transport: applying scientific research to reduce the risk from mercury in Gulf of Mexico seafood]
NCCOS Technical Memorandum



NOAA SCIENTIFIC PUBLICATIONS REPORT
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HIGHLIGHTED ARTICLES

Potential impact of climate change on the intra-Americas sea: Part 2. Implications for Atlantic bluefin tuna and skipjack tuna adult and larval habitats
Journal of Marine Systems (2.476)
B. A. Muhling (NMFS/SEFSC/CIMAS), Y. Liu (OAR/AOML/CIMAS), S. Lee (OAR/AOML/CIMAS), J. Lamkin (NMFS/SEFSC), M. Roffer, F. Muller-Karger, and **J. Walter (NMFS/SEFSC)**

- This paper examines potential climate change impacts on thermal habitats of skipjack and bluefin tunas in the Gulf of Mexico and Caribbean Sea.
- Results showed marked temperature-induced habitat losses for both adult and larval bluefin tuna, with increased habitat suitability for skipjack tuna as temperatures warmed.
- The work suggests that influences of climate change on highly migratory Atlantic tuna species are likely to be substantial, but strongly species-specific.

Increasing water temperatures due to climate change will likely have significant impacts on distributions and life histories of Atlantic tunas. In this study, the authors combined predictive habitat models with a downscaled climate model to examine potential impacts on adults and larvae of Atlantic bluefin tuna (*Thunnus thynnus*) and skipjack tuna (*Katsuwonus pelamis*) in the Intra-Americas Sea (IAS). An additional downscaled model covering the 20th century was used to compare habitat fluctuations from natural variability to predicted future changes under two climate change scenarios: Representative Concentration Pathway (RCP) 4.5 (medium-low) and RCP 8.5 (high). Results showed marked temperature-induced habitat losses for both adult and larval bluefin tuna on their northern Gulf of Mexico spawning grounds. In contrast, habitat suitability for skipjack tuna increased as temperatures warmed. Model error was highest for the two skipjack tuna models, particularly at higher temperatures. While impacts on fish populations remain uncertain, these changes in habitat suitability will likely alter the spatial and temporal availability of species to fishing fleets, and challenge equilibrium assumptions of environmental stability, upon which fisheries management benchmarks are based.
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Available online: http://www.sciencedirect.com/science/article/pii/S0924796315000226



NOAA SCIENTIFIC PUBLICATIONS REPORT
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Long-term NOx trends over large cities in the United States during the Great Recession: comparison of satellite retrievals, ground observations, and emission inventories
Atmospheric Environment (3.062)
D. Q. Tong (OAR/ARL), L. Lamsal**, L. Pan (OAR/ARL)**, C. Ding**, H. Kim (OAR/ARL), P. Lee (OAR/ARL), T. Chai (OAR/ARL),** K. E. Pickering, and **I. Stajner (NWS/OST)**

- This study documents substantial downward trends in nitrogen oxide emissions in eight major U.S. cities during the great recession. The authors detected downward trends of -25, -38, and -35 percent over the time period from 2005 to 2012 based on data from the National Weather Service-led National Air Quality Forecasting Capability (NAQFC), the U.S. EPA ground-based network (Air Quality System or AQS), and the NASA satellite (Ozone Mapping Instrument or OMI), respectively.
- This study demonstrates the feasibility of using satellite and ground-based observations to detect changes in air pollution during an economic event and how these observations can be used to objectively evaluate major updates of emission inventories.

This study examines the impact of the great recession on nitrogen oxide (NOx) emissions in eight major U.S. cities. The study compares changes in NOx emissions trends from the National Weather Service-led National Air Quality Forecasting Capability (NAQFC), the U.S. EPA ground-based network (Air Quality System or AQS), and the NASA satellite (Ozone Mapping Instrument or OMI) over the time period before, during, and after the recession (2005-2012). Both the OMI and AQS detect substantial downward trends, -35 percent and -38 percent, respectively. The NAQFC, which relies on national emissions inventories (NEIs), shows a slower reduction rate (-25 percent). This is likely because the NEI data years are several years behind the forecasting year and do not fully account for the effects of the economic recession. All of the datasets show that the NOx emissions reductions have slowed down after 2009 (during the economic recovery).
Expected publication date: March 2015
Available online: http://dx.doi.org/10.1016/j.atmosenv.2015.01.035



NOAA SCIENTIFIC PUBLICATIONS REPORT
FEBRUARY 18, 2014

An extreme event of sea-level rise along the Northeast coast of North America in 2009–2010
Nature Communications (10.742)
P. Goddard, J. Yin, **S. M. Griffies,** and **S. Zhang (OAR/GFDL)**

- The coastal sea levels along the Northeast Coast of North America show significant year-to-year fluctuations superimposed on an upward trend.
- During the twenty-first century, climate models project an increase in magnitude and frequency of extreme interannual SLR events along this densely populated coast.

In the study, the researchers analyzed long-term tide gauge data and identified an extreme sea level rise event during 2009-10 along the Northeast Coast of the US and Canada. During this 2-year period, the coastal sea level north of New York City jumped by up to 128 mm. They found that this extreme event is closely related to the 30% downturn of the Atlantic Meridional Overturning Circulation (AMOC) during 2009-10.
Expected publication date: February 2015

ADDITIONAL ARTICLES

NOS PUBLICATIONS

Augmenting anti-cancer natural products with a small molecule adjuvant
Marine Drugs (3.512)
P. G. Wahome, K. R. Beauchesne, **A. C. Pedone**, J. Cavanagh, C. Melander, P. Zimba, and **P. D. R. Moeller (NOS/NCCOS)**

- The authors examined the cytotoxicity of four microbial metabolites
- A marine natural product increases the efficiency of both antibiotic activity and cancer treatments, opening up new pharmaceutical avenues to improve human health.
- This work demonstrates the added value of emerging toxin research to the human and environmental health arenas.

Aquatic microbes produce diverse secondary metabolites with interesting biological activities. Cytotoxic metabolites have the potential to become lead compounds or drugs for cancer treatment. Many cytotoxic compounds, however, show undesirable toxicity at higher concentrations. Such undesirable activity may be reduced or eliminated by using lower doses of



the cytotoxic compound in combination with another compound that modulates its activity. Here, the authors have examined the cytotoxicity of four microbial metabolites [ethyl N-(2-phenethyl) carbamate (NP-1), Euglenophycin, Anabaenopeptin, and Glycolipid 652] using three in vitro cell lines [human breast cancer cells (MCF-7), mouse neuroblastoma cells (N2a), and rat pituitary epithelial cells (GH4C1)]. The compounds showed variable cytotoxicity, with Euglenophycin displaying specificity for N2a cells. This study also examined the modulatory power of NP-1 on the cytotoxicity of the other three compounds and found that at a permissible concentration (125 µg/mL), NP-1 sensitized N2a and MCF-7 cells to Euglenophycin and Glycolipid 652 induced cytotoxicity.
Published: December 2014
Available online: http://www.ncbi.nlm.nih.gov/pubmed/25548974

NMFS PUBLICATIONS

Development of an estuarine climate change monitoring program
Ecological Indicators (2.23)
J. Barrett, **J. M. Rose (NMFS/NEFSC)**, J. Pagach, M. Parker, and S. Deonarine

- In this paper, the authors outline a strategic plan to monitor climate change in a Northeast US estuary.
- The new approach combines regional predictions with local monitoring information and the identification and prioritization of sentinels of climate change.
- This approach can be applied to other coastal and estuarine management programs.

Numerous coastal and estuarine management programs around the world are developing strategies for climate change and priorities for climate change adaptation. A multi-state work group collaborated with scientists, researchers, resource managers and non-governmental organizations to develop a monitoring program that would provide warning of climate change impacts to the Long Island Sound estuarine and coastal ecosystems. The goal of this program was to facilitate timely management decisions and adaptation responses to climate change impacts. A novel approach is described for strategic planning that combines available regional-scale predictions and climate drivers (top down) with local monitoring information (bottom up) to identify candidate sentinels of climate change. Using this approach, 37 candidate sentinels of



climate change were identified as well as a suite of core abiotic parameters that are drivers of environmental change. A process for prioritizing sentinels was developed and identified six of high priority for inclusion in pilot-scale monitoring programs. A monitoring strategy and an online sentinel data clearinghouse were developed. The work and processes presented here are meant to serve as a guide to other coastal and estuarine management programs seeking to establish a targeted monitoring program for climate change and to provide a set of "lessons learned.
Accepted: January 2015

Linking behavior, physiology, and survival of Atlantic salmon smolts during estuary migration
Marine and Coastal Fisheries (1.81)
G. S. Stich, G. B. Zydlewski, **J. F. Kocik (NMFS/NEFSC)**, and J. D. Zydlewski

- This study presents the first empirical evidence that dam passage in freshwater affects Atlantic salmon smolt survival during estuary passage, and demonstrates that delayed, dam-related estuary mortality increases with the cumulative number of dams passed during emigration from freshwater.
- The study makes the first direct link between survival of Atlantic salmon smolts during estuary migration and physiological preparedness for salt water entry, which can be related directly to other measures of developmental status such as rearing temperatures in hatcheries.
- The authors highlight examples of direct, important implications of these findings for when and where to stock hatchery-reared Atlantic salmon smolts for species recovery plans in the U.S. and elsewhere.

Decreased marine survival is identified as a component driver of continued declines of Atlantic Salmon *Salmo salar*. However, estimates of marine mortality often incorporate loss incurred during estuary migration that may be mechanistically distinct from factors affecting marine mortality. We examined movements and survival of 941 smolts (141 wild and 800 hatchery-reared) released in freshwater during passage through the Penobscot River Estuary, Maine, USA from 2005 to 2013. We related trends in estuary arrival date, movement rate, and survival to fish characteristics, migratory history, and environmental conditions in the estuary. Fish that experienced the warmest thermal history arrived in the estuary 8 days earlier than those



experiencing the coolest thermal history during development. Estuary arrival date was 10 days later for fish experiencing high flow than for fish experiencing low flow. Fish released furthest upstream arrived in the estuary 3 days later than those stocked further downstream, but moved 0.5 $km \cdot h^{-1}$ faster through the estuary. Temporally, movement rate and survival in the estuary both peaked in mid-May. Spatially, movement rate and survival both decreased from freshwater to the ocean. Wild smolts arrived in the estuary later than hatchery fish, but we observed no change in movement rate or survival attributable to rearing history. Fish with the highest gill NKA activity incurred 25% lower mortality through the estuary than fish with the lowest gill NKA activity. Smolt survival decreased by 40% with increasing number of dams passed (from 2 to 9) during freshwater migration. These results underscore the importance of physiological preparedness on performance and the delayed, indirect effects of dams on survival of Atlantic Salmon smolts during estuary migration, ultimately affecting marine survival estimates.
Expected publication date: March 2015

Heterogeneity among Mycobacterium ulcerans *from French Guiana revealed by multilocus variable number tandem repeat analysis (MLVA)*
PLOS One (3.534)
Y. Reynaud, J. Millet, D. Couvin, N. Rastogi, **C. Brown**, P. Couppié, and **E. Legrand (NMFS/NEFSC)**

- Buruli ulcer is an emerging and neglected tropical disease caused by *Mycobacterium ulcerans*.
- The goal of the present study was to examine the genetic diversity of *M. ulcerans* strains in this region by using the Multilocus Variable Number Tandem Repeat Analysis (MLVA) approach.
- Managing disease organisms is contingent on understanding them and the degree of genetic diversity within their populations.

Few cases have been reported so far in the Americas. With 250 cases reported since 1969, French Guiana is the only Buruli ulcer endemic area in the continent. Thus far, no genetic diversity studies of strains of *M. ulcerans* from French Guiana have been reported. The goal of the present study was to examine the genetic diversity of *M. ulcerans* strains in this region by



using the Multilocus Variable Number Tandem Repeat Analysis (MLVA) approach. A total of 23 DNA samples were purified from ulcer biopsies or derived from pure cultures. MVLA was used in the study of six previously-described Variable Number of Tandem Repeat (VNTR) markers. A total of three allelic combinations were characterized in this study: genotype I which has been described previously, genotype III which is very similar to genotype I, and genotype II which has distinctly different characteristics in comparison with the other two genotypes. This high degree of genetic diversity appears to be uncommon for *M. ulcerans*. Further research based on complete genome sequencing of strains belonging to genotypes I and II is in progress and should lead soon to a better understanding of genetic specificities of *M. ulcerans* strains from French Guiana.
Accepted: January 2015

Diagnosis of paired age agreement: a simulation approach of accuracy and precision effects
ICES Journal of Marine Science (2.525)
R. S. McBride (NMFS/NEFSC)

- This paper examines through simulation various methods used for quality assurance or quality control when aging fish.
- Results support continued use of all three approaches because they are complementary.

In a typical age and growth study, multiple estimates of individual fish age are generated: by readers, methods, etc. These samples of paired data are evaluated using three complementary approaches: 1) tabulate or graph the data to illustrate patterns, 2) calculate indices of precision to evaluate repeatability, and more recently, 3) use tests of symmetry to evaluate bias. Herein, I simulated age data to evaluate the diagnostic power of these different approaches in terms of four types of accuracy: 1) no bias between known and estimated age, 2) bias by adding 1 year to the estimated age, 3) bias by subtracting 10% from the estimated age, and 4) both biases together. Precision of estimated ages (coefficients of variation = 5, 10, and 15%) was varied for each type of bias. Age-bias plots had difficulty detecting bias in ages classes with few (e.g., < 5) individuals sampled. A Bland-Altman-bubble plot is introduced as an alternative to age-bias plots. In these simulations, the various indices of precision were either not diagnostic (i.e., percent agreement) or redundant (average percent error could be predicted from Chang's



coefficient of variation). Evans & Hoenig's test and Bowker's test of symmetry performed well in most simulations, but each has specific weaknesses. Bowker's test was superior by having marginally fewer Type I error rates; however, it had much worse Type II error rates. McNemar's test offered no additional interpretative power in these simulations. All tests of symmetry had difficulty diagnosing bias when precision was low. These simulated results support continued use of all three approaches because they are complementary. Additional simulations would be helpful to confirm that these guidelines are relevant in other representative cases.
Expected publication date: Summer 2015

NESDIS PUBLICATIONS

Natural gas prices and the extreme winters of 2011/12 and 2013/14: causes, indicators, and interactions
Bulletin of the American Meteorological Society (11.57)
C. J. Schreck III (CICS–NC), S. Bennett, J. M. Cordeira, **J. Crouch (NESDIS/NCDC)**, **J. Dissen (CICS–NC)**, A. L. Lang, D. Margolin, A. O'Shay, **J. Rennie (CICS–NC)**, and M. J. Ventrice

- Volatility in the natural gas markets can be linked to large temperature variability over the United States in recent winters.
- A positive Arctic Oscillation is linked to warm temperatures in 2011/12 when prices fell. Strong ridging in the Gulf of Alaska in 2013/14 led to cold temperatures and rising prices.
- This study demonstrated how energy traders and meteorologists use weather and climate data, including NOAA's Climate Data Records, to supplement numerical models and anticipate changes in heating demand.

Day-to-day volatility in natural gas markets is driven largely by variability in heating demand, which is in turn dominated by cool season temperature anomalies over the northeastern quadrant of the United States ("Midwest-East"). Energy traders rely on temperature forecasts at horizons of 2–4 weeks to anticipate those fluctuations in demand. Forecasts from dynamical models are widely available, so the markets react quickly to changes in the model predictions.



Traders often work with meteorologists who leverage teleconnections from the tropics and the Arctic to improve upon the model forecasts. This study demonstrates how natural gas prices react to Midwest-East temperatures using the anomalous winters of 2011/12 and 2013/14. These examples also illustrate how energy meteorologists use teleconnections from the Arctic and the tropics to forecast heating demand. Winter 2011/12 was exceptionally warm, consistent with the positive Arctic Oscillation (AO). March 2012 was a fitting exclamation point on the winter as it featured the largest warm anomaly for the United States above the 20th century climatology of any month since 1895. The resulting lack of heating demand led to record surpluses of natural gas storage and spurred prices downward to an 11-year low in April 2012. In sharp contrast, winter 2013/14 was unusually cold. An anomalous Alaskan ridge led to cold air being transported from Siberia into the United States, despite the AO generally being positive. The ensuing swell in heating demand exhausted the surplus natural gas inventory, and prices rose to their highest levels since the beginning of the global recession in 2008.
Accepted: January 15, 2015
Available online: https://drive.google.com/open?id=0B6xOMPBPulQXZmNDVUk0VVgtTjg

Calculation and evaluation of an air-freezing index for the 1981–2010 climate normals period in the coterminous United States
Journal of Applied Meteorology and Climatology (2.10)
R. Bilotta (ERT, Inc.), J. E. Bell (CICS–NC), **E. Shepard (STG, Inc.)** and **A. Arguez (NESDIS/NCDC)**

- The article proposes new methodology for calculating the air-freezing index for the 1981-2010 climate normals period in the U.S.
- Comparing the 1981–2010 return periods with re-calculated 1951–1980 values using the same new methodology, a decrease in winter severity across much of the coterminous U.S. becomes apparent.

Air-Freezing Index (AFI) is a common metric for determining the freezing severity of the winter season and estimating frost depth for mid-latitude regions, which is useful for determining the depth of shallow foundation construction. AFI values represent the seasonal magnitude and duration of below freezing air temperature. Departures of the daily mean



temperature above or below 0°C (32°F) are accumulated over each August—July cold season; the seasonal AFI value is defined as the difference between the highest and lowest extremes points. Return periods are computed using generalized extreme value distribution analysis. This research replaces the methodology used by the National Oceanic and Atmospheric Association (NOAA) to calculate AFI return periods for the 1951-1980 time period, applying the new methodology to the 1981-2010 climate normals period. Seasonal AFI values and return period values were calculated for 5600 stations across the coterminous United States (CONUS), and the results were validated using United States Climate Reference Network temperature data. Return period values are typically 14-18% lower across CONUS during 1981-2010 versus a re-computation of 1951-1980 return periods with the new methodology. For the 100-year (2-year) return periods, about 59% (83%) of stations show a decrease of more than 10% in the more recent period, whereas 21% (2%) show an increase of more than 10%, indicating a net reduction in winter severity consistent with observed climate change.
Published: January 2015
Available Online: http://journals.ametsoc.org/doi/abs/10.1175/JAMC-D-14-0119.1

OAR PUBLICATIONS

Tropical climate change control of the lower stratospheric circulation
Geophysical Research Letters (4.456)
P. Lin, **Y. Ming**, and **V. Ramaswamy (OAR/GFDL)**

- The behavior of the Brewer-Dobson circulation in response to natural and anthropogenic climate forcings was investigated using a suite of GFDL global climate model simulations, in conjunction with observation-based analysis.
- Variations in this circulation are strongly correlated with those in the tropical-mean surface temperature through changes in upper tropospheric temperature and zonal winds.
- Changes in the Brewer-Dobson circulation constitute an important attribution element of the atmospheric adjustment to global climate change.

Tropical air has less ozone than polar air, even though the tropical stratosphere is where most atmospheric ozone is produced. The Brewer-Dobson circulation is considered key to understanding this apparent contrast. It also brings water vapor, aerosols and other species from



the troposphere up into the stratosphere. The strength of the Brewer-Dobson circulation directly affects the thermal structure of the stratosphere and upper troposphere, and impacts the transport and distribution of important climate-influencing constituents including stratospheric water vapor, ozone, and volcanic aerosols. The authors calculated the strengths of the Brewer-Dobson circulation simulated by GFDL global climate models CM3 and CM2.1, and found that the strengths correlated with the tropical mean surface temperature. This correlation was also supported by observational-based analysis. The variations of the Brewer-Dobson circulation's shallow branch can be explained largely by those of the tropical mean surface temperature. Interestingly, this robust mechanism holds for all forcing types, and operates both at interannual and multi-decadal timescales. This correlation between the stratospheric circulation strength and tropical-mean surface temperature across timescales and forcings indicates that one can constrain the model-simulated long-term changes of the circulation with observations of much shorter durations, and gain more confidence in the climate model projection of stratospheric circulation, composition and its downward impacts on the troposphere and surface.
Expected publication date: March 2015
Available Online: http://onlinelibrary.wiley.com/doi/10.1002/2014GL062823/pdf

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS PUBLICATIONS

White paper on Gulf of Mexico mercury fate and transport: applying scientific research to reduce the risk from mercury in Gulf of Mexico seafood
NCCOS Technical Memorandum
D. Evans, M. Cohen, C. Hammerschmidt**,** W. Landing, D. Rumbold, J. Simons, and S. Wolfe **(NOS/NCCOS)**

- Mitigation approaches will need to recognize the complexity of the mercury pathways, and the need to incorporate the spatial, temporal, and ecological variability of mercury concentrations among water, sediments, and biota and the demographic variability among consumers.



- Mitigation will need to be implemented at the appropriate spatial and temporal scale to achieve the desired results.
- Each of the four approaches (source reduction, consumption advisories, landscape modification, and fisheries management) can be appropriate for a specific situation, which will require an integrated strategy.

Consumption of marine fish is the greatest source of mercury exposure to United States residents. Consumers along the Gulf of Mexico coast are at enhanced risk because of their high levels of seafood consumption and the likelihood that many species of Gulf of Mexico (Gulf) fish have higher levels of mercury than the same species harvested on other coasts. The Authors developed a whitepaper that broadly outlines our current knowledge of mercury in the Gulf of Mexico. The Authors make recommendations of research needs and approaches that, if undertaken, would provide coastal managers with the ability to better ameliorate the toxicological risks of mercury to residents of the Gulf of Mexico, and help fulfill mandated requirements to improve impaired water bodies which EPA and the states typically engage through the Total Maximum Daily Load (TMDL) process. Recommendations for scientific research to achieve risk reduction goals include: identification of at risk groups; identification and quantification of locales where methylmercury enters the food web and processes leading to mercury biomagnification by seafood species; identification of locales where methylmercury is produced from inorganic mercury in the Gulf of Mexico; quantification of inorganic mercury and methylmercury inputs to the Gulf, its estuaries, and open waters via atmospheric deposition, watershed deliveries, and oceanic deliveries from the Atlantic Ocean; predicting and measuring the relationships between mercury inputs to the Gulf and local, regional, national, and global emission sources; and develop mitigation strategies.
Expected publication date: December 2014